ZooKeys 646: 119–137 (2017)
doi: 10.3897/zookeys.646.10897
http://zookeys.pensoft.net

RESEARCH ARTICLE

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Revision of the genus *Tarema* Schaus, 1896 (Lepidoptera, Mimallonoidea, Mimallonidae) with the description of a new species from southeastern Brazil

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Academic editor: *C. Schmidt* | Received 23 October 2016 | Accepted 10 January 2017 | Published 19 January 2017

http://zoobank.org/18BB1484-506F-4F16-8886-21C2D4F63B8B

Citation: St Laurent RA, Herbin D, Mielke CGC (2017) Revision of the genus *Tarema* Schaus, 1896 (Lepidoptera, Mimallonoidea, Mimallonidae) with the description of a new species from southeastern Brazil. ZooKeys 646: 119–137. https://doi.org/10.3897/zookeys.646.10897

Abstract

The genus *Tarema* Schaus, 1896 is revised. The species *T. fuscosa* Jones, 1908 and *T. rivara* Schaus, 1896 are redescribed, the female of the former is described and figured for the first time, and the genitalia of both sexes for each species are figured for the first time. The lectotype of *Tarema macarina* Schaus, 1928, **syn. n.** is determined to be the female of *T. rivara*. *Tarema bruna* **sp. n.** is described from São Paulo, Brazil. Lectotypes for *T. fuscosa*, *T. rivara*, and *T. macarina* are here designated.

Keywords

Distribution, Neotropical, Paraguay, *Tarema bruna* sp. n., *Tarema fuscosa*, *Tarema macarina* syn. n., *Tarema rivara*, taxonomy

Introduction

The genus *Tarema* Schaus, 1896 has been mostly overlooked in the literature since Schaus (1928), save for its mention in two published species lists of Mimallonidae (Gaede 1931, Becker 1996). Recently, however, Herbin and Mielke (2014) reported new collecting data for *T. rivara* Schaus, 1896 quite distant from its type locality,

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displaying the broad distribution of this species. Additionally, Diniz et al. (2013) reported the first life history information for the genus in reference to *T. rivara*, including images of the larva and larval sack, as well as host plant data and the first figures accurately depicting both sexes of this species.

Since Schaus (1928), three species have been included in the genus *Tarema*: *T. rivara*, *T. fuscosa* Jones, 1908, and *T. macarina* Schaus, 1928. Diniz et al. (2013), in figuring both sexes of *T. rivara*, unknowingly revealed the conspecifity of *T. rivara* and *T. macarina*, names applied to the opposite sexes of a single species. We were previously aware of this taxonomic issue, therefore we revise the synonymy and provide accurate figures attributed to the species for aid in future identification. We also provide a distribution map and genitalia figures of both sexes of both species for the first time. Furthermore, a new species is described and figured.

Methods

Dissections were performed as in Lafontaine (2004). Morphological, including genitalia, terminology follows Kristensen (2003). Not all genitalia were prepared on slides to allow for three-dimensional analysis of the complex male genitalia. Genitalia and abdomens, when not slide mounted, are preserved in glycerol filled microvials.

The primary types (when abdomen was present) and at least one specimen from most localities were dissected.

Specimens from the following collections were examined:

CDH	Coll. Daniel Herbin, Garidech, France
CGCM	Coll. Carlos G. C. Mielke, Curitiba, Paraná, Brazil
CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Ontario, Canada
CPAC	Coll. Embrapa Cerrados, Planaltina, Distrito Federal, Brazil
CUIC	Cornell University Insect Collection, Ithaca, New York, USA
DZUP	Coll. Pe. Jesus S. Moure, Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Paraná, Brazil
MNHU	Museum für Naturkunde der Humboldt-Universität zu Berlin, Germany
NHMUK	Natural History Museum, London, U.K.
USNM	National Museum of Natural History [formerly United States National Museum], Washington D.C., USA

Figures were manipulated with Adobe Photoshop CS4 (Adobe 2008). Male genitalia are figured in natural color with CS4 "auto color" used to improve white backgrounds. Female genitalia were treated with "auto tone" in CS4 to darken characters. The map was created with SimpleMappr (Shorthouse 2010) and edited with CS4. All geographical coordinates are approximate, and are based on the localities provided on specimen labels. GPS data were acquired with Google Earth.

Results and discussion

Tarema Schaus, 1896: 55

Type species. *Tarema rivara* Schaus, 1896: 55, by original designation.

Diagnosis. The genus *Tarema* is recognized among the family Mimallonidae by generous amounts of light gray scales present over the entirety of the dorsum and ventrum of the wings, as well as on the thorax and abdomen, giving the species of this genus a hoary appearance. The genitalia of *Tarema* are unique in the family. Male genitalia have short, ovoid valves and spike-covered projections emanating from near the base of the valves that may be associated with the transtilla and/or the gnathos. The gnathos itself is reduced to a flat, movable plate that covers the base of the uncus. Long setae emanate from above the phallus in paired, horsetail-like bunches. The phallus is thick and broad, and has two lengthwise processes terminating in a sharp tip and a curved tip respectively. Female genitalia are robust structures with a medium to large coiled ductus-corpus bursae complex. The sclerotized portion of abdominal segment VIII is broad; appearing wrinkled ventrally, and is covered in thick, branched setae. The genus *Alheita* Schaus, 1928 is somewhat similar to *Tarema* in overall small size, wing shape, and minor resemblance of male genitalia, namely the ovoid valves and odd shape of the uncus which is usually more deeply bifid in *Alheita*.

Description. Male. *Head*: Eyes large, more than two thirds area of head; antenna bipectinate to tip, though pectination reduced along distal fifth of antennal length; labial palpus reduced, three segmented, palpus usually not extending beyond frons, scales generally darker brown dorsally. *Thorax*: Appearing hoary due to banded gray or pale khaki scales interspersed amongst darker ones, prothorax with more heavily concentrated light gray or khaki scales. *Legs*: Coloration as for thorax, though lighter gray, vestiture finer, bushier. Tibial spurs narrow, sharp, mostly clothed in scales. *Forewing dorsum*: Forewing length: 9–16 mm, wingspan: 21.5–32.0 mm. Short, triangular, outer margin nearly straight but slightly convex mesally. Ground color ranging from brown or pale clay-orange to nearly black, overall generously shaded by cream or gray scales giving the wing a hoary, layered appearance. Antemedial line absent or nearly so, faint dark band may be present. Postmedial line nearly straight but may be somewhat inwardly or outwardly bent, line preapical such that submarginal area mostly uniform in width from tornus to apex. Apical half of submarginal area with postmedial lunule. Costa appearing lighter than most of wing due to high concentration of gray or khaki scales. Discal spot a thick streak spanning width of discal cell. *Forewing ventrum*: Antemedial line absent, postmedial line never straight, bulging outward toward wing margin mesally. *Hindwing dorsum*: Submarginal area with orange to reddish patch of scales mesally, discal mark present but smaller. *Hindwing ventrum*: Following same pattern as forewing ventrum. Frenulum as single bristle. *Venation*: Rather typical for Mimallonidae, discal cell quite broad, distal edge sharply slanted (see Schaus 1896). *Abdomen*: Short, barely or not extending beyond anal angle of hindwing. *Genitalia*: Complex; vinculum somewhat ovoid or almost circular, ventrally with reduced sac-

cus. Uncus robust, sharp, parrot beak-like and dorsolaterally flattened or reduced to slightly triangular stump with slight bidentation terminally. Gnathos a flattened or curved plate concealing fingerlike sclerotization of anal tube. Valves short, rounded, weakly sclerotized mesally. Base of valves with pair of fingerlike projections, weakly sclerotized knobby area may be present above fingerlike projections. Valves with or without more heavily sclerotized, spined accessory arms that may or may not be attached basally to valves. Diaphragm with pair of horsetail-like seatal patches consisting of setae of variable length that extend outward over phallus below gnathos plate. Juxta partially fused to phallus, encircling it, lightly sclerotized, with ventral lip connecting phallus to base of vinculum (severed to excise phallus). Phallus broad, large, with two elongated accessory projections. Vesica balloon-like, slightly scobinate, separated into fairly distinct diverticula. **Female.** *Head*: Similar to male, but broader, antennae and labial palpi smaller. *Thorax*: As in male. *Legs*: As in male, though tibial spurs thicker. *Forewing dorsum*: Forewing length: 10.0–18.5 mm, wingspan: 22.0–34.5 mm. As in male but slightly broader, postmedial line usually more noticeably bent. *Forewing ventrum*: Similar to forewing ventrum of male, but veins usually lined with contrasting yellow scales. *Hindwing dorsum*: Coloration and markings as for forewing dorsum. *Hindwing ventrum*: Follows same pattern as forewing ventrum. Frenulum absent. *Abdomen*: As in male but slightly more robust. Tergite VIII as three posteriorly directed lobes or as single broad plate, sternite VIII as wrinkled mass consisting of one or two pieces, covered in thick, branched setae. *Genitalia*: Stout, robust or quite narrow overall; apophyses anteriores highly reduced, apophyses posteriores elongate, spanning length of segment IX. Lamella indistinct due to large sclerotization of sternite VIII. Corpus bursae large, bag-like, coiled, broadly connected beneath sternite VIII /ostium complex, no clear ductus bursae present, occasionally with large, snake-like spermatophore present within corpus bursae. Papillae anales typical of Mimallonidae, appearing rectangular laterally; papillae anales covered with fine setae.

Key to species of *Tarema**

1 Male: coloration mostly clay-brown or orange to more red with abundant gray shading. Valves with heavily sclerotized, flattened, spined structures, or no accessory arms. Phallus with smooth dorsal projection. Female: mostly brown and gray, but may have clay or salmon-orange hue, especially antemedially, darker apical patch absent, tergite VIII trilobed..... **2**

\- Male: coloration mostly dark brown, to nearly black with cream colored shading; valves with heavily sclerotized, tubular, clubbed spine structures; phallus with spined dorsal projection. Female: mostly dark brown to black with gray shading, tergite VIII as singular plate..... ***Tarema fuscosa***

2 Ground color clay-orange to orange-red, postmedial lunule angled away from postmedial line toward wing margin, becoming diffuse before reaching wing margin. Male genitalia with heavily sclerotized, flattened, spined structures, connected lengthwise to short, rounded valve, gnathos as rectangular plate,

dorsal phallus projection broad. Female: tergite VIII with trilobed plate..... ..... ***Tarema rivara***

– Ground color earthen brown, postmedial lunule parallels postmedial line until bending toward wing margin, reaching it. Male genitalia lacking large, heavily sclerotized vincular/valve arms, which are instead reduced to small sclerotizations at base of valve, gnathos as tapered hexagonal plate, dorsal phallus projection thin..... ***Tarema bruna* sp. n.***

*The female of *T. bruna* sp. n. is unknown.

***Tarema rivara* Schaus, 1896**

Figs 1–6, 11, 14, 16

Tarema rivara Schaus, 1896: 55
Tarema rivara; Schaus 1928: 670, fig. 88i ♂
Tarema rivara; Gaede 1931
Tarema rivara; Becker 1996
Tarema rivara; Diniz et al. 2013: 88, figs ♂, ♀, larva, larval sack
Tarema macarina Schaus, 1928: 670, fig. 88i ♀ **syn. n.**
Tarema macarina; Gaede 1931
Tarema macarina; Becker 1996

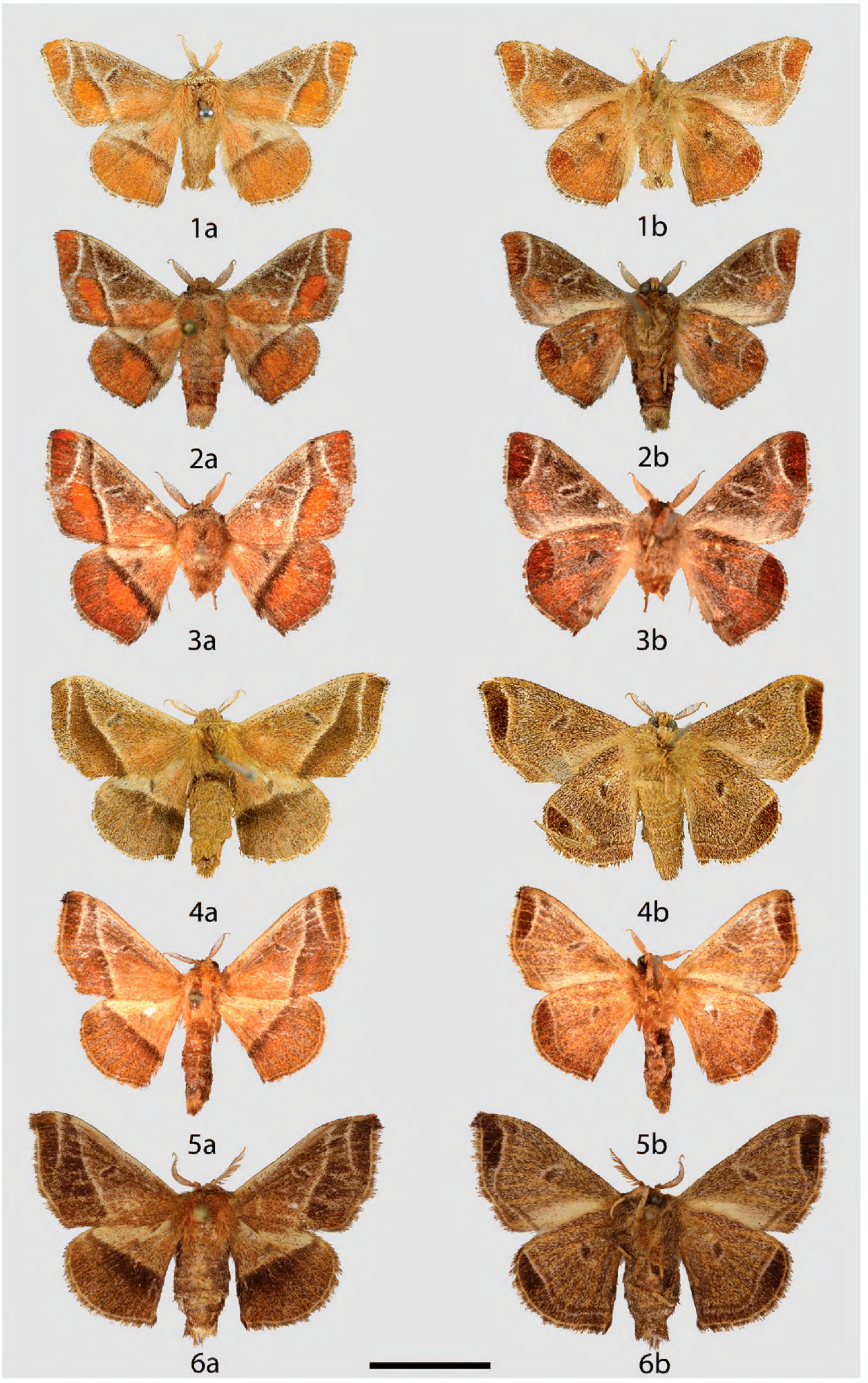
Type material. ***Tarema rivara* Schaus: lectotype [here designated],** ♂. **BRAZIL: São Paulo:** São Paulo, S.E. Brazil./ Collection, WmSchaus/ Type No. 12566 U.S.N.M/ USNM-Mimal: 1120/ *Tarema rivara* Type. Schaus./ LECTOTYPE male *Tarema rivara* designated by St Laurent, Herbin, and C. Mielke, 2017 [handwritten red label]/ St Laurent diss.: 8-22-16:3/ (USNM, examined). Type locality: Brazil: São Paulo.

***Tarema macarina* Schaus: lectotype [here designated],** ♀. **BRAZIL: São Paulo:** 1 ♀, São Paulo, S.E. Brazil./ Collection, WmSchaus/ Type No. 33596 U.S.N.M/ USNM-Mimal: 1121/ *Tarema macarina* Type Schaus/ LECTOTYPE female *Tarema macarina* designated by St Laurent, Herbin, and C. Mielke, 2017/ *Tarema rivara* det. St Laurent 2016/ St Laurent diss.: 8-22-16:2/ (USNM, examined). **Paralectotypes,** 2 ♀. **BRAZIL: São Paulo:** 1 ♀, Brasil. m., S. Paulo 96/ Typus/ Coll. Staudinger/ *Tarema macarina* Schaus, co-type/ (MNHU, photograph examined). **Unknown state:** 1 ♀, Brasil [illegible]/ *Tarema macarina* co-type Schaus/ 8582/ (MNHU, photograph examined). Type locality: Brazil: São Paulo. – All paralectotypes with the following yellow label: PARALECTOTYPE ♀ *Tarema macarina* designated by St Laurent, Herbin, and C. Mielke, 2017.

Additional specimens examined. (28 ♂, 14 ♀) **BRAZIL: Maranhão:** 1 ♂, Feira Nova do Maranhão, Retiro, 07°00'31"S, 46°26'41"W, 480 m: 16–17.II.2013, C. Mielke leg., Coll. C. Mielke 26.333 (CGCM). **Bahia:** 1 ♂, Barreiras, 12°9'S, 45°00'W, 700 m: 4.II.1994, Coleção EMBRAPA-CPAC No. 15.987, [Camargo leg.] (CPAC). **Mato**

Grosso: 1 ♀, Chapada [dos] Guimarães: 25.V.1989, V.O. Becker leg., Coll. Becker 75031, USNM-Mimal: 2320 (USNM). 1 ♂, No specific locality: XII.1929, Coll. R. Spitz, Rothschild Bequest 1939–1 (NHMUK). **Goiás:** 1 ♂, Ponte Funda, Vianópolis: 24.X.1987, Tangerini leg., genitalia prep. D. Herbin ref H. 1010 (CDH). 1 ♀, Ipameri: 10.X.1988, V.O. Becker leg., Coll. Becker 59419, USNM-Mimal: 2323, St Laurent diss.: 8-22-16:8 (USNM). **Distrito Federal:** 1 ♂, 1 ♀, Estação Florestal, Cabeça do Veado, 1100 m: 17.X.1971, 23.X.1971, E.G., I. & E.A. Munroe leg., St Laurent diss.: 3-14-16:7, 3-14-16:8 (CNC). 5 ♂, 2 ♀, Planaltina, 15°35'S, 47°42'W, 1000 m: 1–10.XI.1994, Tangerini leg. (1 ♂, CDH); 25.IX.1985, 5.XI.1988, V.O. Becker leg., Coll. Becker 57771, 58871, 58872, USNM-Mimal: 2301–2304, 2321, 2322 (4 ♂, 2 ♀, USNM). 1 ♂, Planaltina: 15.X.1995 (MWM). **Minas Gerais:** 1 ♂, Serra do Cipó à Conceição do Mato Dentro, km 126.3, 19°14'51"S, 43°30'38"W, 1270 m: 18.XI.2012, genitalia prep. D. Herbin ref H. 1012 (CDH). 1 ♂, Malacacheta, 500 m: I.1998, H. Thöny leg., genital prep. 29.234 (MWM). 1 ♂, Sete Lagoas, 720 m: 15.III.1974, V.O. Becker leg., Coll. Becker 411, USNM-Mimal: 2300 (USNM). 1 ♂, Paracatu, 17°13'S, 46°52'W, 920 m: 5.II.1994, Coleção EMBRAPA-CPAC No. 14.664 (CPAC). 1 ♂, Iraí de Minas, 18°43'S, 47°30'W, 950 m: 9.II.1994, Coleção EMBRAPA-CPAC No. 14.145 (CPAC). 1 ♂, São Roque de Minas, São José do Barreiro, 870 m, 3.XII.2016, C. Mielke leg., Coll. C. Mielke 32.162 [point not on map] (CGCM). **São Paulo:** 2 ♂, Ribeirão Preto, Fazenda da Pedra, Rio Tamanduá: Travassos & Pearson leg., 12–15.X.1953 (NHMUK); HRP 643, USNM-Mimal.: 2425 (USNM). 1 ♂, Locality as for previous but 500 m: 2–5.III.1954, Pearson & Oiticica leg., Brit. Mus. 1962–112 (NHMUK). 1 ♂, Alto da Serra [Paranapiacaba]: I.1926, R. Spitz leg., Rothschild Bequest 1939–1, St Laurent diss.: 7-7-16:4 (NHMUK). 1 ♂, Miracatu, 700 m: 20.XI.1997, H. Thöny leg., genital prep. 29.233 (MWM). 2 ♂, 2 ♀, No additional locality data: E.D. Jones Coll., Brit. Mus. 1919–295 (NHMUK); Rothschild Bequest 1939–1 (NHMUK). 1 ♂, No specific locality, 750 m: E.D. Jones Coll., Brit. Mus. 1919–295, NHMUK010354581, St Laurent diss.: 8-29-16:5 (NHMUK). **Paraná:** 1 ♂, Campo do Tenente, 850 m: 17.X.1985, [O.] Mielke leg., DZ 15.496 (DZUP). 1 ♂, Ponta Grossa: II.1957, at light, No. 1780, Coll. F. Justus Jor (DZUP). 1 ♀, Castro, 950 m: E.D. Jones leg., E.D. Jones Coll., Brit. Mus. 1919–295 (NHMUK). 1 ♀, Tucunduva [Sengés], 650 m: 17.II.1913, E.D. Jones leg., E.D. Jones Coll., Brit. Mus. 1919–295 (NHMUK). **Santa Catarina:** 1 ♂, No additional locality data: F. Hoffmann leg., USNM-Mimal: 2681, St Laurent diss.: 8-22-16:7 (USNM). **No state:** 1 ♀, "Bresil", Joicey Coll. Brit. Mus. 1925–157 (NHMUK). **PARAGUAY: Cordillera:** 1 ♀, Pirareta, 25°29'S, 56°56'W, 200 m: 26–31.VIII.2012, [U. Drechsel] leg., genitalia prep. D. Herbin ref H. 1014 (CDH). **Amambay:** 1 ♀, Estancia Oliva, 22°10'S, 56°26'W, 225 m: 23–25.I.2013, [U. Drechsel leg.], (CDH). **Guairá:** 1 ♀, Villarica: 2.X.1925, F. Schade leg., J.J. Joicey Esq., B.M. 1929–458, St Laurent diss.: 7-7-16:5 (NHMUK). **Paraguarí:** 1 ♀, Sapucay [*recte* Sapucai]: 12.VIII.1904, W. Foster leg., Rothschild Bequest 1939–1 (NHMUK).

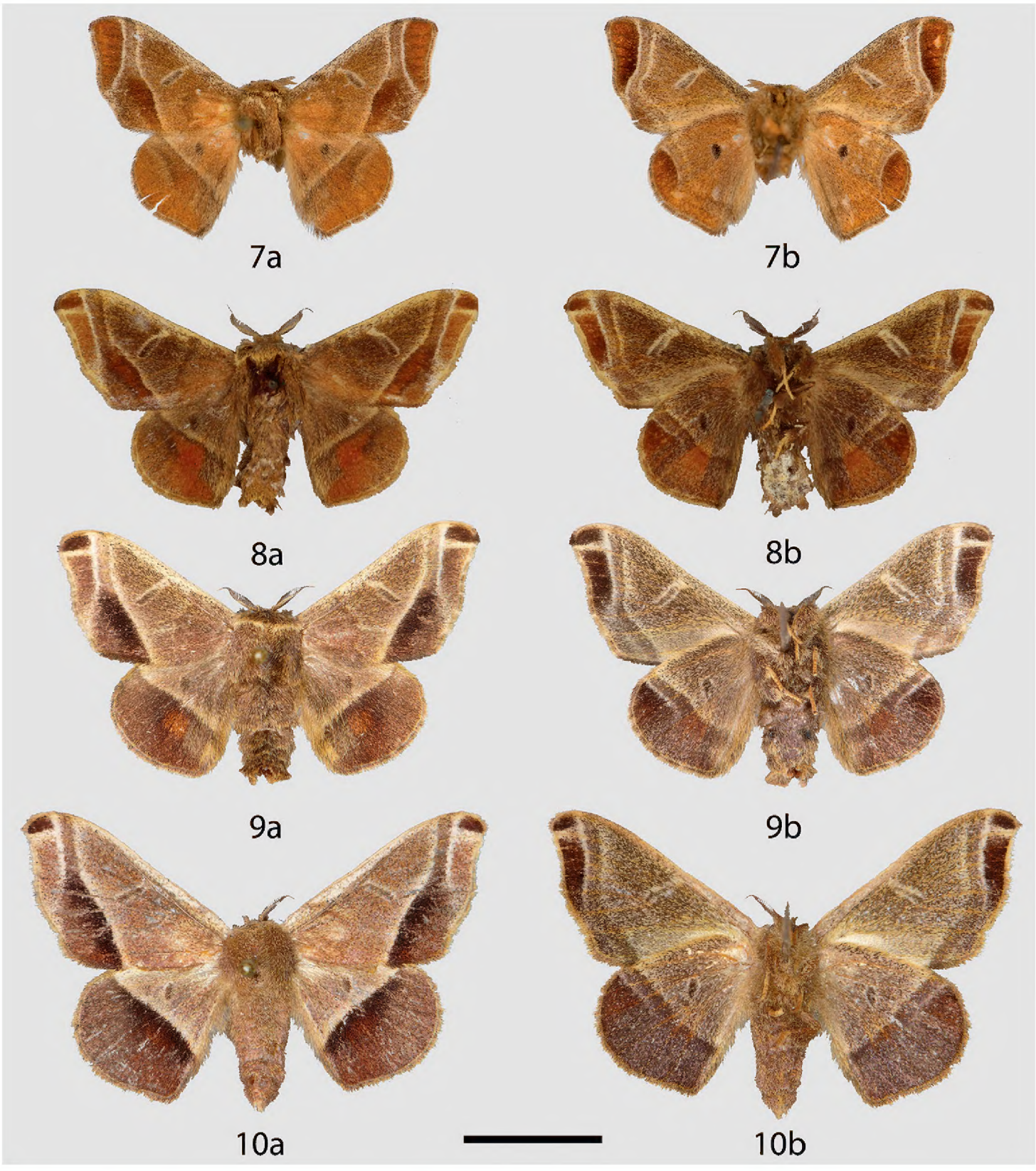
Diagnosis. *Tarema rivara* can be differentiated from others in the genus by the pervasive orange to orange-red coloration on the wings in males, and by the faint orange



Figures 1–6. *Tarema rivara* adults, **a** dorsal **b** ventral. **1** ♂, Lectotype, Brazil, São Paulo (USNM) **2** ♂, Brazil, Maranhão, Feira Nova do Maranhão, Retiro, 480 m [image originally published by Antenor, reused with permision] (CGCM) **3** ♂, Brazil, Minas Gerais, Serra do Cipó à Conceição do Mato Dentro, km 126.3, 1270 m (CDH) **4** ♀, Lectotype of *Tarema macarina* syn. n., Brazil, São Paulo (USNM) **5** ♀, Paraguay, Amambay, Estancia Oliva, 225 m (CDH) **6** ♀, Brazil, Distrito Federal, Estação Florestal, Cabeça do Veado, 1100 m (CNC). Scale bar: 1 cm.

hue on the wings of the females which is concentrated antemedially and/or submarginally. The more similar *T. bruna* sp. n. is more earthen brown in color than *T. rivara*, with a longer postmedial lunule that reaches the wing margin without becoming diffuse. In both sexes, *T. rivara* has a smaller wingspan than *T. fuscosa* and lacks a distinct dark brown patch of scales at the apex of the forewings. This patch of scales is distinct in *T. fuscosa* due to the contrast with the light cream color of the postmedial lunule that borders it. Genitalia are quite different between these species, in *T. rivara* the valves are reduced to small lobes connected to a flattened, spiny accessory, while the valves of *T. fuscosa* and *T. bruna* sp. n. are larger and not connected to, or lack the accessory arms. The gnathos of *T. rivara* is a rectangular plate rather than ovoid as in *T. fuscosa*, or tapered hexagonal as in *T. bruna* sp. n., the fingerlike projections at the base of the valves are smaller in *T. rivara*, and finally the phallus of *T. rivara* (and *T. bruna* sp. n.) bears a smooth dorsal projection whereas the same projection is short and spined in *T. fuscosa*. The key differences in female genitalia are the larger corpus bursae in *T. rivara* and the trilobed tergite VIII, which is a broad, singular plate in *T. fuscosa*. The female tergite can usually be examined under a microscrope after brushing off scales, without dissecting the specimen.

Description. Male. *Head*: As for genus, gray with orange undertone, antenna coloration as for head. *Thorax*: Coloration similar to that of head, but more orange, appearing hoary due to banded gray scales interspersed amongst orange hued ones, prothorax covered almost entirely in light gray scales. *Legs*: As for genus but tibia mostly orange. *Forewing dorsum*: Forewing length: 9–13 mm, avg.: 11.5 mm, wingspan: 21.5–29.0 mm, n=16. Ground color ranging from clay-orange to almost brick red, overall generously shaded by gray scales giving the wing a hoary, layered appearance, especially medially. Postmedial line as for genus but coloration light cream and bordered externally with black scaling continuously along length. Antemedial area with salmon orange hue, medial area always lighter gray compared to orange or reddish submarginal area. Apical half of submarginal area with postmedial lunule, the latter never parallel with margin or postmedial line, either smoothly curved toward margin or angled acutely from postmedial line, becoming diffuse before reaching wing margin, basal half of submarginal area with bright orange or red patch along postmedial line. Discal spot as for genus. Fringe light gray to khaki with lighter and darker patches, including salmon colored scales. *Forewing ventrum*: Similar to dorsum but usually lighter due to more extensive covering of gray scales; antemedial line absent, postmedial line very faint, bulging outward toward wing margin mesally. Postmedial lunule present as on dorsum, more distinct than postmedial line. *Hindwing dorsum*: Coloration as for forewing dorsum, following similar patterning but antemedial line absent, postmedial line slightly concave, and submarginal area always orange to more reddish, postmedial lunule absent or just a faint suffusion, coloration usually concentrated somewhat mesally. *Hindwing ventrum*: Following same pattern as forewing ventrum. *Abdomen*: As for genus, concolorous with thorax. *Genitalia*: (Fig. 11) n=12. Vinculum almost circular. Uncus robust, sharp, parrot beak-like when viewed laterally, uncus dorsolaterally flattened. Gnathos a rectangular, elongated plate with slight curvature mesally. Valve short, rounded, weakly sclerotized mesally, strongly affixed to vinculum such that they



Figures 7–10. *Tarema* adults, **a** dorsal **b** ventral. **7** *T. bruna* holotype ♂, Brazil, São Paulo, Alto da Serra [Paranapiacaba] (NHMUK) **8** *T. fuscosa* lectotype ♂, Brazil, Paraná, Castro (NHMUK) **9** *T. fuscosa* ♂, Brazil, São Paulo, Guapiara, Paivinha, 800 m (CGCM) **10** *T. fuscosa* ♀, Brazil, São Paulo, Guapiara, Paivinha, 800 m (CGCM). Scale bar: 1 cm.

do not open fully. Base of valves with pair of small, fingerlike projections, weakly sclerotized knobby area present above fingerlike projections. Valve with more heavily sclerotized, spined accessory arms attached basally to valves, arms originate from transtilla or base of valve (unclear), connected along length of valve. Accessory arms flattened and ventrally spined. Diaphragm with pair of horsetail-like seatal patches consisting of setae of variable length that extend outward over phallus for about three-quarters length of gnathos plate, setae mostly straight. Phallus broad, large, with two elongated

accessory projections of variable length, projection superior to phallus smooth, straight, sharply pointed; other projection shorter, narrower, running laterally along phallus originating from within phallus, tip of second projection sharp, but variously bent, size of phallus relative to projections somewhat variable. Vesica balloon-like, slightly scobinate. **Female.** *Head*: Similar to male, but broader, antennae and labial palpi smaller. *Thorax*: As in male, but usually grayer or occasionally more salmon colored. *Legs*: As in male, though tibial spurs thicker. *Forewing dorsum*: Forewing length: 10–15 mm, avg.: 12.1 mm, wingspan: 22–30 mm, n=13. Sexual dimorphism strong, wing shape and markings similar to male, but wing broader, coloration usually much more subdued gray and brown, if salmon hue present, generally restricted to antemedial area, though rarely some specimens with salmon hue more pervasive, especially submarginally, otherwise submarginal area solid brown, postmedial lunule usually fainter than in male, sometimes almost absent except for small streak. Fringe with distinctly black portion apically. *Forewing ventrum*: Similar to forewing ventrum of male, but salmon hue generally absent, veins usually lined with contrasting yellow scales, wing grayer overall but apical region more distinctly solid brown than in male. *Hindwing dorsum*: Coloration and markings as for forewing dorsum, though postmedial lunule absent. *Hindwing ventrum*: Follows same pattern as forewing ventrum. *Abdomen*: As in male but slightly more robust, coloration subdued. Tergite VIII as three posteriorly directed lobes, sternite VIII as large, curved, wrinkled mass, covered in thick, branched setae. *Genitalia*: (Fig. 14) n=5. As for genus, two dissections with large, snake-like structure, apparently a spermatophore based on presence in one dissected male, present within corpus bursae. Papillae anales narrow.

Distribution (Fig. 16). This species has a wide distribution in South America, and although most records come from Brazilian Cerrado in Bahia, Maranhão, Mato Grosso, Goiás, Minas Gerais, and Distrito Federal, *T. rivara* is also known from Brazilian Atlantic Forest in São Paulo, mixed ombrophilous forest in the state of Paraná, and inland forests of Paraguay. We are also aware of one specimen from Santa Catarina, though unfortunately it lacks more detailed data that would allow us to understand the habitat in which it inhabits in this state.

Natural history. Diniz et al. (2013) report *T. rivara* larvae feeding on Vochysiaceae, including the species *Qualea grandiflora*, *Q. multiflora*, and *Q. parviflora*. The same authors describe the larval sack as being constructed from leaves, silk, and feces. These larval sacks are of the less uniformly constructed variety in Mimallonidae, and are thus more similar to those of *Lacosoma* Grote, 1864 and *Cicinnus melsheimeri* (Harris, 1841) rather than highly compacted, rigid structures as seen in *Menevia* Schaus, 1928, *C. packardii* (Grote, 1865), or *C. bahamensis* St Laurent & McCabe, 2016, among others (R. A. St. Laurent pers. obs.).

Remarks. In the original description of *T. rivara*, Schaus (1896) stated: "What I believe to be the ♀ of this species has the reddish shades replaced by dark brown." Apparently Schaus was well aware of the dimorphism of *T. rivara* at the time of its original description, thus it is somewhat surprising that he described the female of *T. rivara* as a new species, *T. macarina*, over 30 years later (Schaus 1928). We are also

aware of a *T. rivara* female specimen determined as this species and not *T. macarina* at the NHMUK. However, we infer that Schaus changed this earlier determination due to the fact that he had located what he believed to be the male of *T. macarina* in the MNHU as per the following statement from Schaus (1928) in his treatment of *T. macarina*: "A male of this species is in the Berlin museum." Two syntypes of *T. macarina* are present in the MNHU with Schaus's handwriting on the "type" labels; however, both specimens are female, as is the lectotype (here designated) in the USNM.

The complete lack of any male specimens correctly determined as *T. macarina* and the unusual disparity of female *T. rivara* led us to believe that these names are synonyms. Many records of *T. rivara* and *T. macarina* are sympatric, and thus support this hypothesis. A close analysis of *T. rivara* females reveals hints of orange coloration antemedially, a coloration abundant in the male specimens, but not in *T. fuscosa*. Given that *T. fuscosa* females can be easily determined as such due to the lack of sexual dimorphism in this species, the disparity of opposite sexes for *T. rivara* and *T. macarina* provides clear evidence that they represent a single, dimorphic species. Furthermore, a dissection of *T. rivara* females reveal the long, snake-like spermatophore seen in male *T. rivara*, unlike the smaller spermatophore of *T. fuscosa*.

Diniz et al. (2013) figure a larva and adults of both sexes of *T. rivara*, correctly figuring the female of *T. rivara*, which again, matches the type specimens of *T. macarina*.

Compared to *T. fuscosa* below, this species seems to primarily be an inhabitant of drier Cerrado but is also present in the more humid Atlantic forest in the states of São Paulo (type locality) and Paraná where it is sympatric with *T. fuscosa*, but apparently not synchronic. In these regions of sympatry, *T. rivara* flies during the summer (October through February), while *T. fuscosa* flies in the winter, though exceptions to these flight times are present in regions where both species are not found together.

***Tarema fuscosa* Jones, 1908**

Figs 8–10, 12, 15, 16

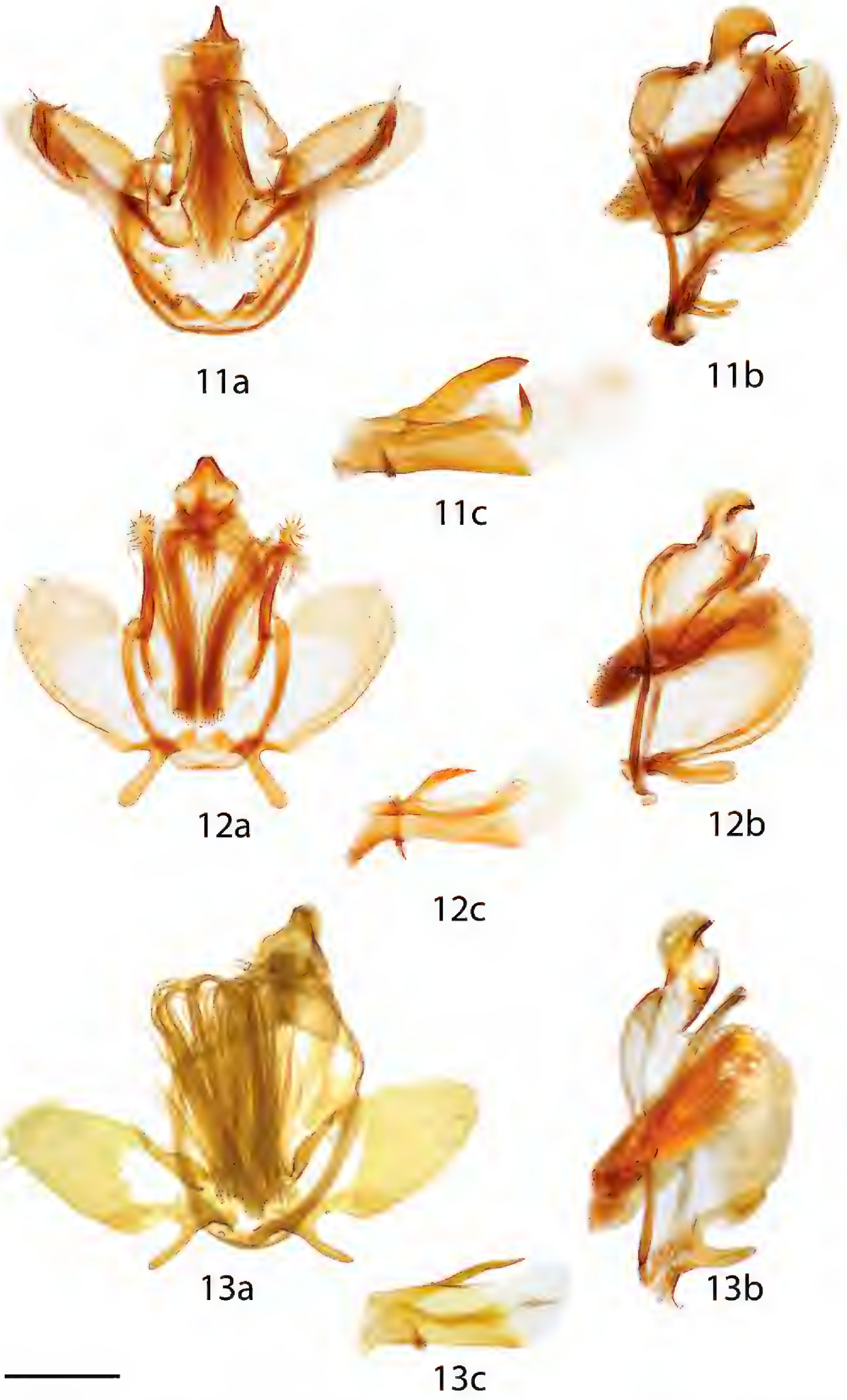
Tarema fuscosa Jones, 1908: 173–174
Tarema fuscosa; Schaus 1928: 670, fig. 88i ♂
Tarema fuscosa; Gaede 1931
Tarema fuscosa; Becker 1996

Type material. Lectotype [here designated], ♂. **BRAZIL: Paraná:** Castro, Paraná, 950 m, E.D. Jones / *Tarema fuscosa* Type D. Jones/ E.D. Jones Coll., Brit. Mus., 1919–295/ BMNH(E) #805428/ SYN-TYPE/ NHMUK010354542/ [genitalia] VIAL NHMUK010402134/ LECTOTYPE male *Tarema fuscosa* designated by St Laurent, Herbin, and C. Mielke, 2017 [handwritten red label]/ (NHMUK, examined). Type locality: Brazil: Paraná: Castro.

Additional specimens examined. (114 ♂, 4 ♀) **BRAZIL: Distrito Federal:** 1 ♂, Estação Florestal, Cabeça do Veado, 1100 m: 17.X.1971, E.G., I. & E.A. Mun-

roe leg., St Laurent diss.: 3-14-16:10 (CNC). 2 ♂, Parque do Gama: 10.X.1971, E.G. Munroe & K.S. Brown leg., St Laurent diss.: 3-14-16:9 (CNC). **Bahia:** 35 ♂, 1 ♀, env. Camacan (SB), 15°25'S, 39°34'W, 800m: X.2011, XI.2011, XII.2011, H. Thöny leg., genital prep. 29.217 (MWM). 1 ♂, env. Camacan (SB), 750 m: IV.2011, H. Thöny leg. (MWM). 1 ♂, 1 ♀, env. Camacan, ca. 750 m: 10–14.XI.2010, Th. Greifenstein leg. (MWM). 2 ♂, Camacan, 15°24'S, 39°30'W: III.2011, H. Thöny leg. (MWM). 1 ♂, Maraú, Fazenda Água Boa, 14°13'S, 39°29'W, 150 m: IV.2011, H. Thöny leg. (MWM). 2 ♂, env. Camacan, 15°25'S, 39°34'W, 800 m: X.2012, H. Thöny leg. (MWM). **Espírito Santo:** 10 ♂, Santa Leopoldina, Village Tirol, 24°75'S, 40°50'W, 700 m: 22–31.X.1996, 20.II–30.III.1997, V.1997, 15.V.1997, VIII.1997, 15.IX.1997, VI.1998, X.1999, H. Thöny leg. (MWM). 5 ♂, Santa Leopoldina, Village Tirol, 700 m: III.1999, VI.1999, X.1999, III.2000, H. Thöny leg. (MWM). 1 ♂, Santa Leopoldina, Village Tirol, 20°10'S, 40°33'W, 700 m: XI.2000, H. Thöny leg. (MWM). 9 ♂, Santa Leopoldina, Boqueirão, 600 m: 15.II.1997, VI.1997, 15.IX.1997, H. Thöny leg. (MWM). 2 ♂, No additional locality data: USNM-Mimal: 2729, 2730 (USNM). **Rio de Janeiro** 1 ♂, Barreira, Teresópolis: 18.X.1955, Coll. Gagarin (DZUP). 1 ♂, Petrópolis: 19.XI.1928, Gagarin leg., Coll. Gagarin (DZUP). 4 ♂, Parque Nacional do Itatiaia, Lago Azul, 800 m: 20–22. VI.1955, R. Barros, D. Albuquerque, & Pearson leg. (NHMUK). 1 ♂, Itatiaia, Horto Florestal (=horticultural garden), 800 m: 10.VIII.1953, Travassos & Pearson leg., Brit. Mus. 1962-112 (NHMUK). 1 ♂, No additional locality data: Coll. Thalenhorst, Coll. Staudinger (MNHU). **São Paulo:** 9 ♂, 1 ♀, Guapiara, Paivinha, 800 m: 5–6.XI.2004 (1 ♂), 24–27.VII.2005 (2 ♂), 18.VII.2007 (1 ♂), 11.VIII.2007 (3 ♂, 1 ♀), 12.IX.2007 (2 ♂), C. Mielke leg., Coll. C. Mielke 25.772, 26.433, 26.535, 26.537, 26.680, 26.955, 26.977, 27.060, 28.074, 28.106 (CGCM). 1 ♂, Embu-Guaçu: Sitío, L. Travassos F. leg. (CDH). 4 ♂, Apiaí, 750 m: 8.VIII.2006 (2 ♂), 7.IX.2007 (2 ♂), C. Mielke leg. (CDH). 1 ♂, Ypiranga [*recte* Ipiranga, São Paulo]: V.1924, R. Spitz, Rothschild Bequest, BM 1939–1 (NHMUK). 2 ♂, Alto da Serra [Paranapiacaba]: VI.1926, VII.1928, R. Spitz leg., Rothschild Bequest, BM 1939–1 (NHMUK). 2 ♂, Salesópolis, Boracea [Boracéia], 850 m: 26.VIII.1949, Travassos, Travassos Filho, Pearson, & Rabello leg., Brit. Mus. 1962-112 (NHMUK); 23–26.V.1952, Pearson leg., 528, USNM-Mimal: 2424 (USNM). **Paraná:** 2 ♂, Ponta Grossa: IV.1948, No. 1552, Coll. F. Justus Jor (DZUP). 1 ♂, Tijucas do Sul [*recte* Guaratuba], Castelhanos, 20°26'S, 54°39'W [coordinates likely incorrect], 500 m: 1.VI.1999, H. Thöny leg. (MWM). **Santa Catarina:** 1 ♂, São Bento do Sul, Rio Vermelho, Road to Rio Natal, 26°20'00.77"S, 49°18'28.25"W, 503 m: no date, Rank leg., genitalia prep. D. Herbin ref H. 1013 (CDH). 8 ♂, São Bento do Sul, Rio Natal, 850 m: VI.1998, VII.1998, VIII.1998, IX.1998, X.1998, VII.1999, H. Thöny leg. (MWM). 1 ♂, Blumenau: E. Wenzel S.G. leg. (MNHU). 1 ♂, No additional locality data: St Laurent diss.: 2-26-16:7 (CUIC). 1 ♂, No additional locality data/illegible: Dognin Coll., 269, USNM-Mimal: 2678 (USNM). **No state:** 1 ♀, "Brasil", Mssn. G. (MNHU).

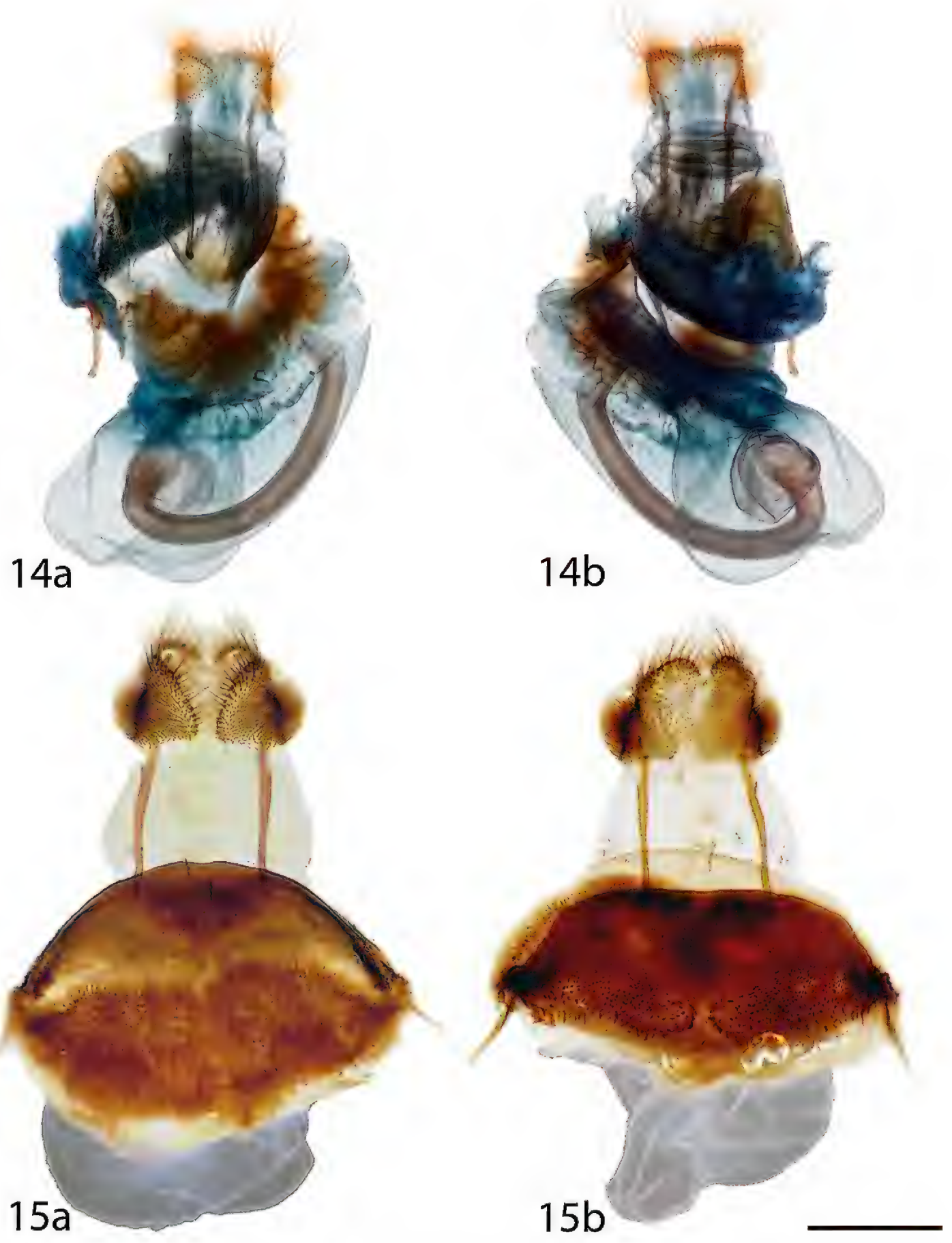
Diagnosis. Compared to the other two species in the genus, *T. fuscosa* is easily recognized by the very dark brown to nearly black ground color, with a dark patch at



Figures 11–13. *Tarema* male genitalia, **a** ventral **b** lateral **c** phallus lateral. **11** *T. rivara*, Brazil, Distrito Federal, Estação Florestal, Cabeça do Veado, 1100 m, St Laurent diss.: 3-14-16:7 (CNC) **12** *T. fuscosa*, Brazil, Santa Catarina, St Laurent diss.: 2-26-16:7 (CUIC) **13** *T. bruna* holotype, Brazil, São Paulo, Alto da Serra [Paranapiacaba], NHMUK010402168 genitalia prep. [13b horizontally flipped] (NHMUK). Scale bar: 1 mm.

the apex of the forewings surrounded by pale cream markings. The male genitalia is unique in having heavily sclerotized, spiny, club-like vincular arms that are not connected lengthwise to the valves. This is also the only species in the genus with an ovoid gnathos plate. Additionally, the dorsal projection of the phallus is short and spiny, not smooth as in the other two species. The female genitalia have a smaller corpus bursae than in *T. rivara* and a broad singular tergite VIII, as opposed to the trilobed corresponding tergite of *T. rivara*.

Description. Male. *Head*: As for genus, grayish brown; antenna coloration usually as for head, though pectination darker brown than flagellum; labial palpus reduced, apparently three segmented, but third segment much reduced. *Thorax*: Coloration similar to that of head, though appearing hoary due to banded brown and pale khaki to cream colored scales, prothorax with more heavily concentrated khaki or cream colored scales. *Legs*: Coloration as for thorax, though femur and tibia darker brown, tarsus lighter, cream colored. *Forewing dorsum*: Forewing length: 11–16 mm, avg.: 13.8 mm, wingspan: 22–31 mm, n=17. Ground color ranging from pale reddish brown to nearly black, overall generously shaded by cream colored scales giving the wing a hoary, layered appearance. Postmedial line as for genus, but coloration light cream not bordered externally with black except for darkened region concentrated near to tornus. Ante- and median areas usually concolorous, submarginal area with reduced cream colored scales, appearing much darker red-brown, brown, to nearly black. Apical half of submarginal area with postmedial lunule, the latter either slightly curved toward wing margin, or nearly parallel with margin, especially along apical half of lunule, basal half of submarginal area with darker red-brown or black patch along postmedial line, apex with darker brown patch outlined by white lunule and cream colored patch immediately beneath darker apical patch. Costa appearing lighter than most of wing due to heavy concentration of cream or khaki colored scales. Discal spot as for genus. Fringe light gray to khaki with lighter and darker patches. *Forewing ventrum*: Similar to dorsum but usually lighter due to more extensive covering of cream and khaki scales, some of which appear yellowish, apical half of submarginal area darker than that of dorsum, except where interrupted by lighter band below apical patch; antemedial line always absent, postmedial line never straight, angled outward toward wing margin mesally. *Hindwing dorsum*: Coloration as for forewing dorsum, following similar patterning but antemedial line absent, postmedial line slightly concave, and submarginal area more uniformly dark reddish brown, dark brown, or black, always with contrasting orange patch of scales mesally. *Hindwing ventrum*: Following same pattern as forewing ventrum, postmedial lunule reduced to straight, faint streak. *Abdomen*: As for genus, concolorous with thorax. *Genitalia*: (Fig. 12) n=7. Vinculum somewhat ovoid, ventrally with reduced saccus. Uncus robust but reduced to slightly triangular stump with slight bidentation terminally. Gnathos an ovoid, elongated, mesally indented plate. Valves short, rounded, weakly sclerotized mesally. Base of valves with pair of long, fingerlike projections. Valves with more heavily sclerotized, spined accessory arms connected to vinculum. Accessory arms narrow and tube-like, terminating in enlarged club end with spines concentrated terminally or present along entire length of arm. Diaphragm with pair of horsetail-like setal patches consisting of very



Figures 14, 15. *Tarema* female genitalia, **a** ventral **b** dorsal. **14** *T. rivara*, Brazil, Distrito Federal, Estação Florestal, Cabeça do Veado, 1100 m, St Laurent diss.: 3-14-16:8 (CNC) **15** *T. fuscosa*, Brazil, São Paulo, Guapiara, Paivinha, 800 m, C. Mielke genitalia prep. CGCM 26.955 (CGCM). Scale bar: 1 mm.

long setae that extend outward over phallus below gnathos plate, setae curled backward at end. Phallus broad, large, widened distally, with two elongated accessory projections, one projection more variable in length, superior to phallus, irregular, pointed, spined; other projection longer, narrower, running laterally along phallus originating from within phallus, tip of second projection sharp, angled backward. Vesica balloon-

like, slightly scobinate, separated into fairly distinct diverticula. **Female.** *Head*: Similar to male, but broader, antennae and labial palpi smaller. *Thorax*: As in male, though cream colored scales may be a bit yellower. *Legs*: As in male. *Forewing dorsum*: Forewing length: 17.0–18.5 mm, avg.: 17.5 mm, wingspan: 31.0–34.5 mm, n=3. Sexual dimorphism reduced, as in male but slightly broader, postmedial line usually more noticeably bent. *Forewing ventrum*: Similar to forewing ventrum of male, but veins usually lined with yellow scales. *Hindwing dorsum*: Coloration and markings as for forewing dorsum, orange mesal patch present in male very faint in female. *Hindwing ventrum*: Follows same pattern as forewing ventrum. *Abdomen*: As in male but slightly more robust. Tergite VIII as single broad plate, sternite VIII as wrinkled mass consisting of two pieces, covered in thick, branched setae. *Genitalia*: (Fig. 15) n=1. As for genus but particularly stout, robust. Corpus bursae somewhat reduced in size.

Distribution (Fig. 16). Although we report a few records from central Brazil (Distrito Federal), most records of this species are restricted to the Brazilian Atlantic Forest in the states of Bahia, Espírito Santo, Rio de Janeiro, São Paulo, Paraná, and Santa Catarina. See remarks for potential issues pertaining to the Cerrado records.

Remarks. As mentioned in the remarks of *T. rivara*, *T. fuscosa* shows a trend in distribution where it is more commonly encountered in humid Atlantic Forest than elsewhere in Brazil. Although we do have some records of *T. fuscosa* from Distrito Federal, there is a possibility that they were mislabeled. Out of over 100 examined specimens of *T. fuscosa*, the only Cerrado material was from the same collector, who also collected in regions where *T. fuscosa* would be more expected, such as the Brazilian states of Paraná and São Paulo. We could not locate any *T. fuscosa* specimens from the Cerrado among the Mimallonidae specimens collected there in the USNM, NHMUK, or CPAC.

Prior to this work, the female of *T. fuscosa* was not reported in the literature; therefore we describe and figure it here for the first time.

Tarema bruna sp. n.

http://zoobank.org/F649B060-A03F-4CD2-BF63-F35071A6B9A1

Figs 7, 13, 16

Type material. Holotype, ♂. **BRAZIL: São Paulo:** Alto de [*recte* da] Serra, [Paranapiacaba, Santo André], São Paulo, November, 1922. (R. Spitz [leg.])./ Rothschild Bequest BM 1939-1/ [genitalia] VIAL NHMUK010402168 / NHMUK010318286/ HOLOTYPE male *Tarema bruna* St Laurent, Herbin, & C. Mielke, 2017 [handwritten red label]/ (NHMUK). Type locality: Brazil: São Paulo: Paranapiacaba.

Diagnosis. Externally this species is most similar to *T. rivara*, but can be easily distinguished by the earthen brown and clay brown coloration rather than orange or red-orange in *T. rivara*. Additionally, in *T. bruna* sp. n. the postmedial lunule reaches the wing margin without becoming highly diffuse, and is parallel to the wing margin for its entire length until bending outward. The male genitalia is unique in the extreme reduction of the heavily sclerotized vincular/valve arms, present as a small extension at

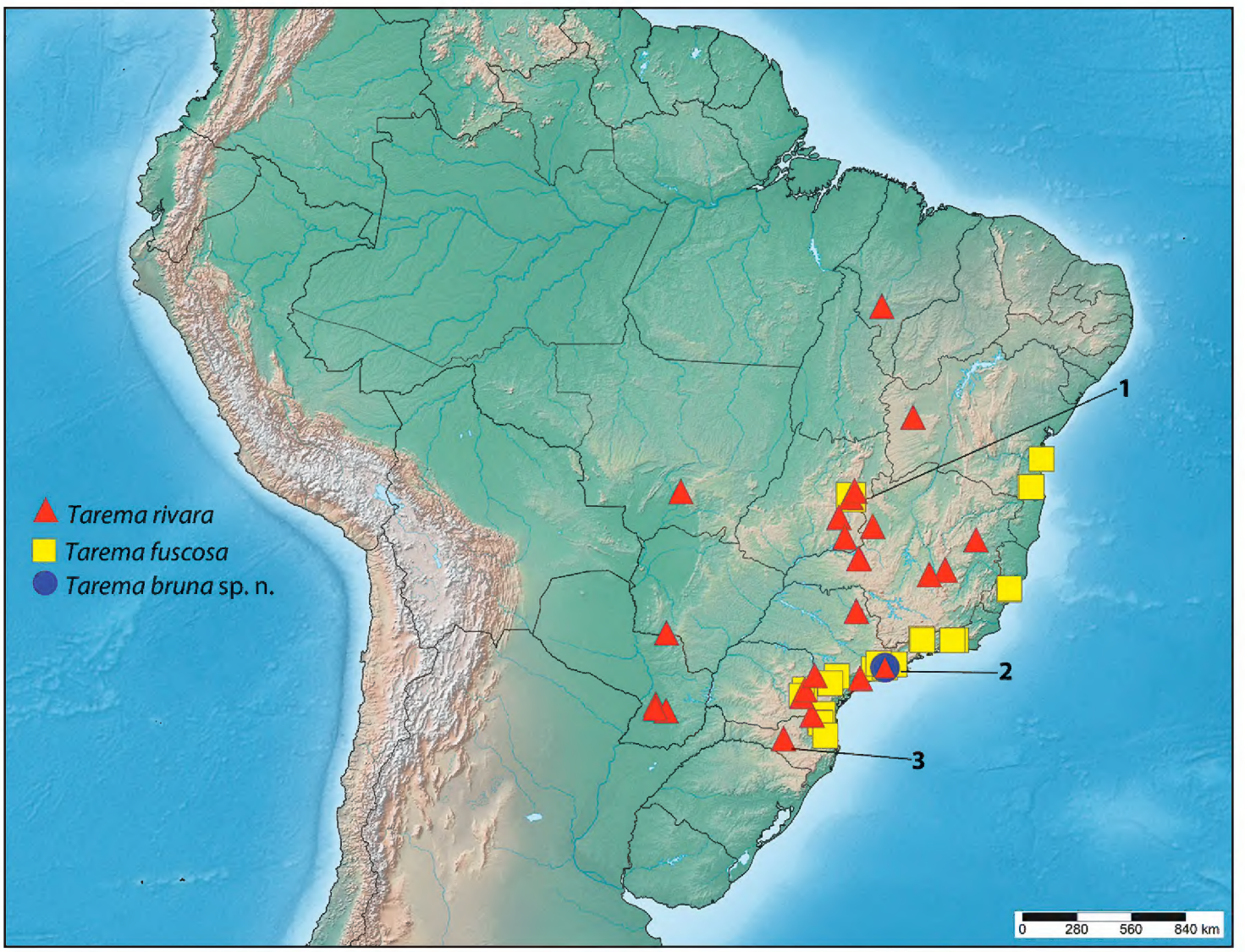


Figure 16. Known distribution of *Tarema*. Numbers superimposed on the map refer to the following annotations: **1** Outlier data point for *T. fuscosa* in Brazil, Distrito Federal may be erroneous (see remarks for that species). **2** The point where all three symbols are found on top of each other is a single locality, that being Brazil, São Paulo, Paranapiacaba. **3** Data point for *T. rivara* in Brazil, Santa Catarina is placed at the center of the state because no detailed locality data is available for this species from Santa Catarina.

the base of the valves. The phallus is also unique in the thinness of the dorsal projection, which is smooth as in *T. rivara*, not spined as in *T. fuscosa*.

Description. Male. *Head*: As for genus, coloration earthen brown. *Thorax*: Coloration similar to that of head, appearing hoary due to banded gray and cream colored scales interspersed amongst brown ones, prothorax covered almost entirely in these lighter scales. *Legs*: As for genus. *Forewing dorsum*: Forewing length: 13 mm, wingspan: 26 mm, n=1. Ground color a mixture of earthen brown tones and clay-brown, overall generously shaded by cream colored scales giving the wing a hoary, layered appearance, especially medially. Antemedial line faint, brown, wavy. Postmedial line as for genus but wavier, coloration light cream, not bordered by darker scales except for a small external portion above the tornus. Antemedial area with salmon orange hue, medial area lighter brown compared to darker submarginal area. Apical half of submarginal area with postmedial lunule, the latter parallel with margin, then smoothly curved toward margin reaching wing margin without becoming diffuse, basal half of submarginal area darkest brown, apical portion external to lunule lighter brown. Discal spot as for genus. Fringe light cream with lighter and darker patches. *Forewing ventrum*: Similar

to dorsum but lighter due to more extensive covering of gray and cream colored scales; antemedial line absent, postmedial line faint, bulging outward toward wing margin mesally. Postmedial lunule present as on dorsum, more distinct than postmedial line. *Hindwing dorsum*: Coloration as for forewing dorsum, following similar patterning but antemedial line absent, postmedial line straight and faintly outlined by black scales, postmedial lunule very faint. *Hindwing ventrum*: Following same pattern as forewing ventrum, though discal mark very dark, well defined as black oval. *Abdomen*: As for genus, concolorous with thorax. *Genitalia*: (Fig. 13) n=1. Vinculum somewhat ovoid, ventrally with reduced saccus. Uncus robust but reduced to slightly triangular stump. Gnathos a tapered, elongated, hexagonal plate. Valves short, rounded. Base of valves with pair of long, fingerlike projections. Slightly more strongly sclerotized, small projections emanate from base of valves. Diaphragm with pair of horsetail-like setal patches consisting of very long setae that extend outward over phallus below gnathos plate, setae curled backward at end. Phallus broad, large, widened distally, with two elongated accessory projections, one projection superior to phallus, smooth, narrow, pointed, other projection longer, narrower, running laterally along phallus originating from within phallus, tip of second projection sharp, angled forward. Vesica balloon-like. **Female.** Unknown.

Distribution (Fig. 16). This new species is so far known only from the type locality at Paranapiacaba (previously known as Alto da Serra, a train station), São Paulo, Brazil. According to GoogleEarth, the elevation at this locality is approximately 700 m.

Etymology. This species is named for its brown (*bruna* Latin) coloration, which largely distinguishes it from the red or orange *T. rivara* and the black, gray, and cream-colored *T. fuscosa*.

Remarks. The discovery of a unique new species of *Tarema* from eastern São Paulo is surprising because this is a relatively well-surveyed region of Brazil (R. A. St. Laurent pers. obs.). Both *T. rivara* and *T. fuscosa* have been collected from the type locality of *T. bruna* (NHMUK), though at different times of the year. As previously mentioned in the remarks of *T. rivara*, that species is primarily a summer species, with records from Paranapiacaba in January, while *T. fuscosa* has only been collected there in the winter (June and July). More material of *T. bruna* will be needed to verify its voltinism.

An issue is presented by the fact that the type localities of *T. rivara*, *T. macarina*, and *T. bruna* are all from São Paulo, Brazil with specific type locality information from within the state only available for *T. bruna*. Therefore, the possibility arose that the name *T. macarina* could be wrongfully synonymized with *T. rivara* if indeed it is conspecific with the new species described herein. However, we consider the apparent rarity of *T. bruna* combined with the genitalia similarities between the lectotype of *T. macarina* and other *T. rivara* females dissected from São Paulo and elsewhere, including Cerrado regions, more suggestive that the name *T. macarina* does in fact represent the female of *T. rivara*, a much more commonly collected and widespread species. If future evidence were found to contradict our hypothesis, *T. bruna* would then be a junior and subjective synonym of *T. macarina*. It is therefore necessary that more material of *T. bruna* be found or collected, particularly in aim to locate the female of this species.

Acknowledgements

The Cornell University College of Agriculture and Life Sciences Alumni Association award and Thomas Witt (MWM) covered travel expenses of R. A. St. Laurent. Stefan Naumann (Germany) provided photographs of all *Tarema* specimens at MNHU. Alexey Prozorov (MWM) offered assistance in photographing specimens and performed and photographed genitalia preparations of *Tarema* in MWM. Alessandro Giusti (NHMUK), Thomas Witt (MWM), Harald Sulak (MWM), Jason Dombroskie (CUIC), Brian Harris (USNM), Christian Schmidt (CNC), Amabílio Camargo (CPAC), and Mirna Casagrande (DZUP) provided access to specimens in their respective institutions. We would also like to thank Christian Schmidt and Roger Hutchings (Brazil) for their review of the manuscript. The journal Antenor gave us permission to reuse a photo of *T. rivara* from Maranhão that they had previously published. Publication of this article was funded by the University of Florida Open Access Publishing Fund.

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